CONTROL AND SECURITY SYSTEM FOR GAS OVENS

TECHNICAL FIELD

The present invention relates to control systems for gas ovens, and more specifically to control systems for gas ovens, which include the functions of ignition and flame monitoring, as well as blocking the passage of gas in the event of a fault.

PRIOR ART

Gas ovens are known that comprise a gas burner, oven operating means for a user to regulate the operation of said oven, means for maintaining the oven in a selected temperature, flame sensing means for detecting the presence of a flame in the burner, a gas valve that receives the signal of said flame sensing means, and an ignition module to ignite the burner when the user acts on the oven operating means, starting the oven.

In this type of gas ovens, the operating means include a knob, the user starting the oven by pressing and rotating said knob. A cooking temperature is selected by rotating the knob. Furthermore, by pressing, the gas valve opens and the ignition module is activated. If the flame sensing means comprise a thermocouple, the user should press the control down for the time required for the flame to become established and for it to heat said thermocouple, so that the thermocouple produces the energy necessary to maintain the gas valve open. If the flame accidentally goes out, the energy generated by the thermocouple is no longer sufficient to maintain the gas valve open and it closes.

U.S. Pat. No. 3,963,410 discloses a gas oven control system having a manual rotary valve controlling gas flow to main and pilot burners and a solenoid operated valve controlling flow to the main burner, control circuit

controlling flow to the main burner, control circuit means embodying spark ignition means to ignite the pilot, means responsive to conduction through pilot flame to cut off spark ignition and permit operation of the solenoid valve , and variable resistance means responsive to oven temperature effecting cyclic operation of the solenoid valve.

U.S. Pat. No. 5,791,890 describes a gas oven control having an electronic controller for directly controlling the gas valve and burner ignition. The controller opens the gas valve and activates the ignitor whenever oven heating is required, and then determines whether ignition has occurred. The gas valve is closed if ignition does not occur within a predetermined time, and re-ignition may be attempted. In order to maintain the oven around a selected temperature, the electronic controller causes the valve to close if the oven temperature is greater than said selected temperature, and causes the valve to open and the ignitor to be energized if the oven temperature is below the selected temperature.

DISCLOSURE OF THE INVENTION

The object of the invention is to provide a control system for gas ovens that is safe, reliable, simple to use for the user and versatile, permitting additional features to be included.

The control and safety system of the invention comprises oven operating means for a user to regulate the operation thereof, means for maintaining the oven around a temperature selected by the user, flame sensor means for detecting the presence of a flame in the burner, a gas valve whereby the supply of gas to the gas burner is opened or closed, and a ignition module to ignite the

burner.

The system also comprises an electronic controller which receives a first signal from the operating means representative of the user regulation, and a second signal from the flame sensor means representative of the existence of a flame, said electronic controller acting, in accordance with the first and second signals, on the gas valve and on the ignition module.

In this way, the user only has to act on the operating means selecting the cooking temperature. From said point, it is the electronic controller that opens the gas valve to permit the passage of gas and acts on the ignition module to ignite the burner, continually monitoring the presence of flame. Therefore, it is a system that is easily handled by the user.

The means for maintaining the oven around a selected temperature comprise gas flow regulating means whereby the gas outflow to the gas burner is regulated in accordance with the temperature in the oven and the selected temperature. The gas outflow that reaches the burner is regulated linearly. In this way, a substantially constant temperature is produced in the oven, unlike the peaks and troughs said temperature shows when it is regulated by an ''all or nothing'' regulating system, i.e. closing the gas valve when a temperature greater than the selected temperature is reached and opening said gas valve and re-igniting the burner when the temperature goes below said selected temperature.

The system of the invention is safe and reliable. During the initial igniting process if, after a preset safety period, the presence of a flame is not detected, the gas valve closes. Furthermore, if, during the cooking process, the flame is extinguished, the electronic controller, which checks at all times the signal that it

receives from the flame sensor means, attempts the re-ignition, shutting down the system if the flame is not lit in said re-ignition.

System safety and reliability is increased by the fact that the electronic controller does not need to close the gas valve each time that the temperature in the oven is greater than the selected temperature and does not need to open the gas valve and act on the ignition module each time that the temperature in the oven is below the selected temperature. Failure probability of the system is substantially reduced, as the ignition process only starts when the user starts the oven and when the flame is accidentally extinguished.

Besides, the gas valves used in the ''all or nothing'' regulating systems are more expensive than the ones that can be used in the invention. On the other hand, the noise generated by the ignition module in the ''all or nothing'' regulating systems each time that said ignition module is started during the normal operation of the oven, is avoided in the present invention.

System safety is also increased by the fact that the electronic controller also checks its own status, closing the gas valve if any anomaly is detected. In this sense, a fail-safe system such as that disclosed in the patent US 6,354,830 B1 can be incorporated in the system of the invention.

Finally, the system of the invention is versatile, which permits easily adding additional features thereto. Other features and advantages of the invention will be evident in the light of the detailed description of the invention.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic diagram of a first embodiment

of the invention.

FIG. 2 is a schematic diagram of a second embodiment of the invention.

FIG. 3 is a graphic showing the temperature in an oven once the oven is started, the selected temperature, the sparks generated by the ignition module, the situation of the gas valve (open or closed) and the flame (present or not present), corresponding to a control system of the prior art.

FIG. 4 is a graphic showing the temperature in an oven once the oven is started, the selected temperature, the sparks generated by the ignition module, the situation of the gas valve (open or closed) and the flame (present or not present), corresponding to the control system of the invention.

DETAILED DESCRIPTION OF THE INVENTION

In the embodiments of the invention of FIGS. 1 and 2, the gas oven comprises a gas burner 1 and the control and safety system of the invention comprises:

- oven operating means for a user to regulate the operation of said oven;
- means for maintaining the oven around a temperature Ts selected by the user;
- flame sensor means 3 for detecting the presence of a flame in the burner 1;
- a gas valve 4 whereby the supply of gas to the burner 1 is opened or closed;
- a ignition module 5 to ignite the burner 1, e.g. generating sparks close to said burner 1; and
- an electronic controller 6 which receives a first signal 7 from the operating means representative of the user regulation, and a second signal 8 from the flame sensor means 3 representative of the existence of a

flame, said electronic controller 6 acting, in accordance with said signals 7 and 8, on the gas valve 4 and on the ignition module 5. Said electronic controller 6 comprises a microprocessor.

The means for maintaining the oven around the temperature Ts selected by the user comprise gas flow regulating means that regulate the gas outflow to the burner 1 in accordance with the temperature in the oven and said selected temperature Ts. In the embodiments of figures 1 and 2, the gas flow regulating means comprise a gas thermostat 2.

The electronic controller 6 of the system of the invention does not need to close the gas valve 4 each time that the temperature in the oven is greater than the selected temperature Ts and does not need to open the gas valve 4 and act on the ignition module 5 each time that the temperature in the oven is below the selected temperature Ts, as is needed in the ''all or nothing'' regulating systems of the prior art.

As can be seen in FIG. 3, in said ''all or nothing'' regulating systems, the gas valve 4 is closed when the temperature in the oven exceeds the selected temperature Ts, and the gas valve 4 has to be open again and a new spark has to be generated by the ignition module 5 when said temperature goes below said selected temperature Ts. On the contrary, as shown in FIG. 4, in the system of the invention, the gas valve 4 is open and a spark is generated in the beginning and, unless there is a failure (the flame is extinguished, for example), the gas valve 4 is maintained open and no further sparks are needed.

As shown in FIGS. 3 and 4, the oscillation of the temperature in the oven around the selected temperature Ts is greater in the ''all or nothing'' regulating systems than in the system of the invention (about ±10°C

versus about ±2°C). Besides, in the system of the invention there is a progressive stabilization of the temperature in the oven with time.

In the embodiment of figure 1, the operating means comprise a knob 9 which regulates the gas thermostat 2, the oven temperature being selected by said knob 9 and activating, at that time, a switch 10. The electronic controller 6 receives, through the signal 7, the status of said switch 10. If said switch 10 is activated, the electronic controller 6 opens the gas valve 4 and acts on the ignition module 5 causing it to produce sparks.

In this embodiment, the temperature is selected by rotating the knob 9 and the switch 10 is a rotating switch. Furthermore, the gas valve 4 and the gas thermostat 2 are incorporated in a single device, forming a safety thermostat. Said gas valve 4 may be for example a solenoid gas valve.

When the presence of a flame is detected, the ignition module 5 is deactivated. If there is still no flame after a safety period has passed after the activation of the switch 10, the electronic controller 6 closes the gas valve 4, the system being shut down. If there is a flame, said electronic controller 6 maintains the gas valve 4 open throughout the cooking process in normal operating mode, understanding normal operating mode to be that wherein the electronic controller 6 does not detect any fault in any of the system components, in which case the gas valve 4 would be closed, blocking the system.

After igniting the oven, if the electronic controller 6 detects the absence of a flame during the cooking process, it makes the ignition module 5 initiate the re-ignition of the flame in the burner 1. If, after the preset safety period has passed, there is still no

flame present, the electronic controller 6 closes the gas valve 4 and shuts down the system.

With the system shut-down, the electronic controller 6 opens the gas valve 4 and activates the ignition module 5 to attempt the re-ignition. If there is still no flame after the re-ignition, the electronic controller 6 closes the gas valve 4 and shuts down the system. This attempt of re-ignition will be repeated a determined number of times. If the flame is not lit during any of the attempts of re-ignition, the gas valve 4 will be closed and the system will be blocked, the intervention of the user being necessary to start the oven.

The electronic controller 6 has a maximum preset cooking time, after which, if the gas valve 4 is still open, said gas valve 4 closes and blocks the system. In this way, it avoids the oven from staying lit uninterruptedly due to the forgetfulness of the user.

In the embodiment of figure 2, the operating means further comprise a timer 11 wherein the user sets the cooking time. Said timer 11 receives a signal 12 representative of the status of the switch 10, and the signal 7 that the electronic controller 6 receives from the operating means is the output signal of said timer 11, the electronic controller 6 operating in accordance with a starting time and a finishing time. The starting time or the finishing time, or both the starting time and the finishing time are set in said timer 11 by the user. If only the starting time is set, the finishing time will be that when the user operates the knob 9, and vice-versa.

The electronic controller 6 opens the gas valve 4 and causes the ignition module 5 to produce sparks at the starting time. Once a determined time has passed since said starting time, the electronic controller closes the

gas valve 4 if there is no flame and, if there is a flame, said electronic controller 6 maintains the gas valve 4 open throughout the cooking process in normal operating mode until the finishing time.

After igniting the oven, the electronic controller 6, which continuously checks the signal that it receives from the flame sensor means, makes the ignition module 5 initiate the re-ignition of the flame in the burner if it detects the absence of a flame.

The electronic controller 6 closes the gas valve 4 and shuts down the system if, after detecting the absence of a flame and initiating the re-ignition, there is still no flame present. With the system shut-down, once a determined time has passed, the electronic controller 6 opens the gas valve 4 and activates the ignition module 5 to attempt the re-ignition, closing the gas valve 4 and shutting down the system if there is still no flame present after the re-ignition. This attempt of re-ignition will be repeated either until the flame is lit or until a determined number of failed attempts occur. If the flame is not lit during any of the attempts of re-ignition, the gas valve 4 will close and will block the system. Furthermore, as with the first embodiment, in this case, the electronic controller 6 will have a maximum preset cooking time.

In a third embodiment, not shown in the figures, the gas flow regulating means are controlled by the electronic controller 6 in accordance with a signal representative of the oven temperature said electronic controller 6 receives. Thus, in said embodiment, all the variables, including temperature regulation, are controlled by the electronic controller.

In the three embodiments, the electronic controller 6 checks its own status, closing the gas valve 4 if it

detects any anomaly. In this way, the system is also safe if the electronic controller has an internal fault.

These embodiments will also comprise viewing means, not represented in the figures, which permit the user to know the status of the oven at all times.